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THE TIME FACTOR IN INDUSTRY

*by* E. W. Hancock, M.B.E., M.I.P.E.

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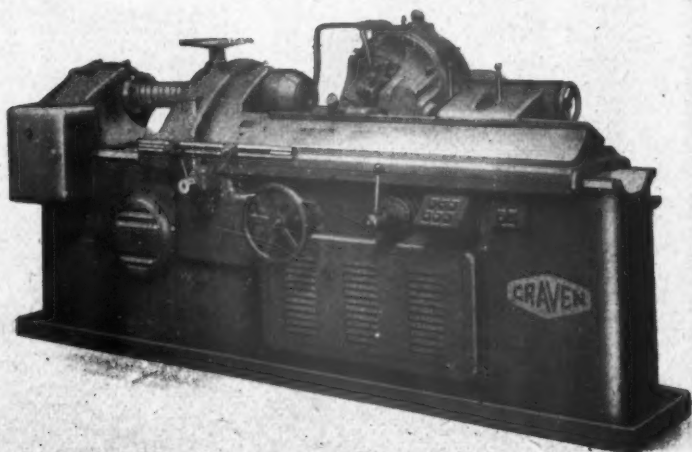
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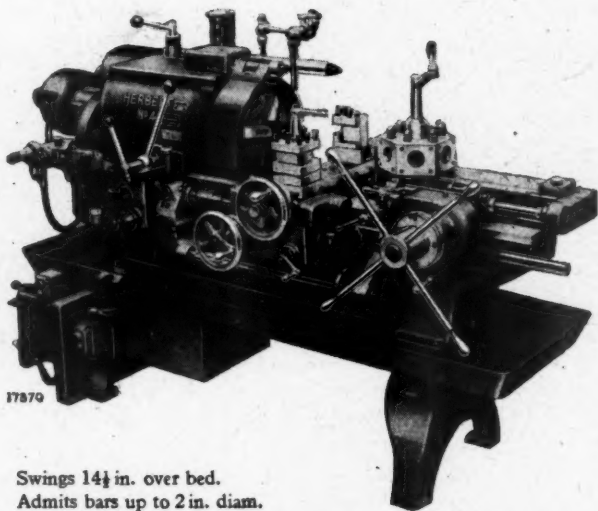


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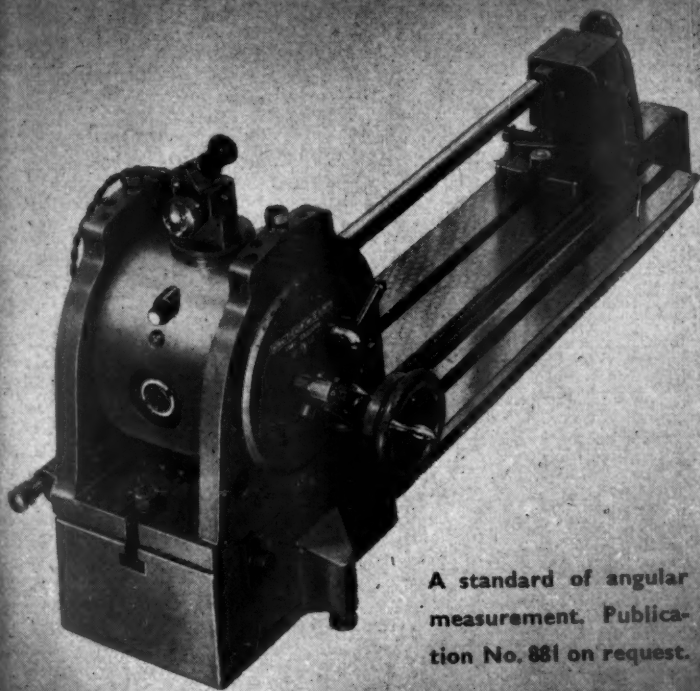
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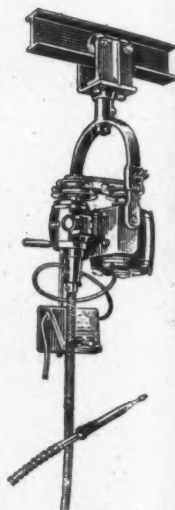


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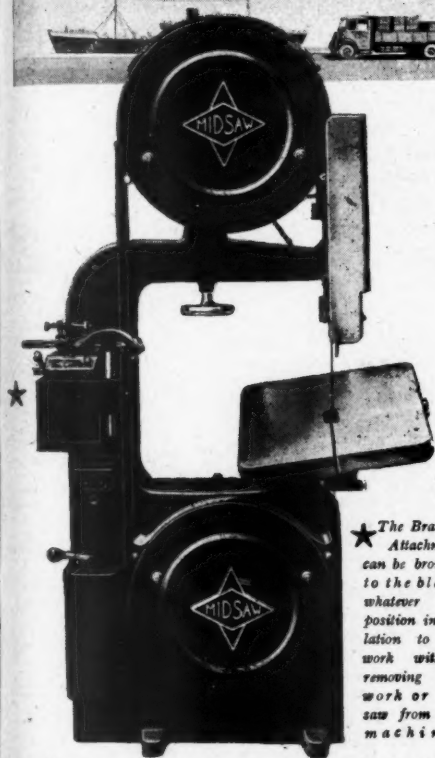
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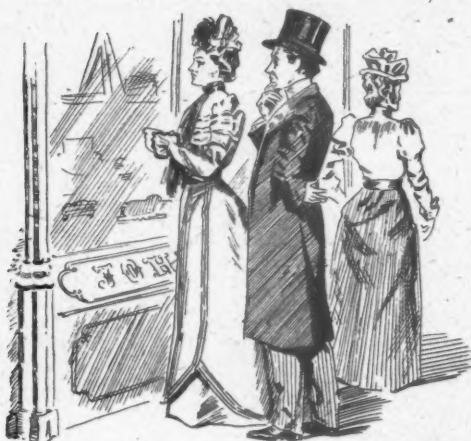
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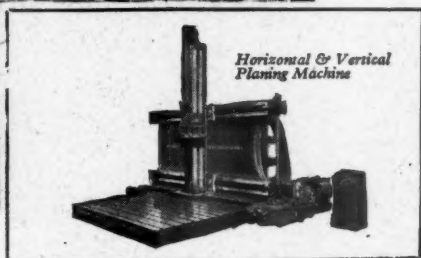
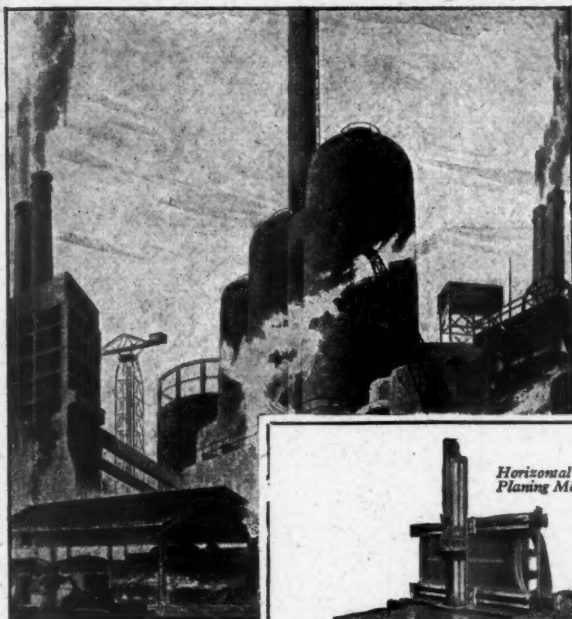
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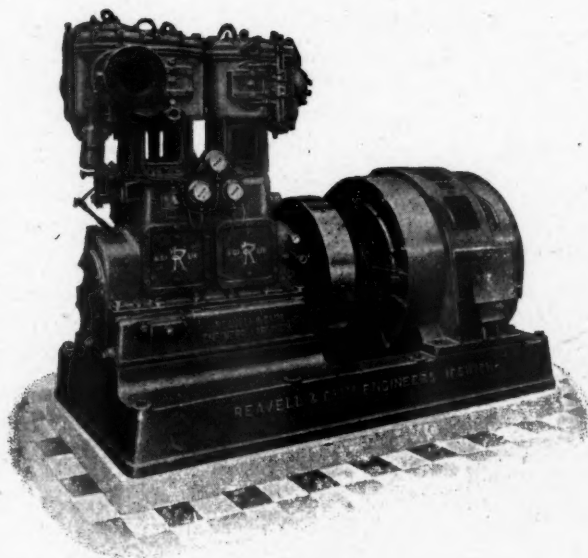
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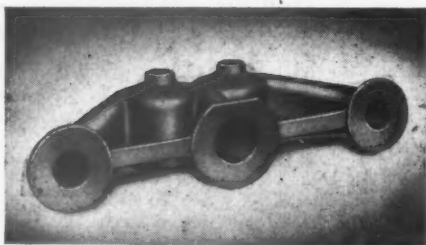
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## THE TIME FACTOR IN INDUSTRY

*Paper presented to the Institution, Wolverhampton  
Section on 20th December, 1944, by  
E. W. Hancock, M.B.E., M.I.P.E.*

### Introduction.

THERE can be no question that "Time" is the most important factor in the scheme of things.

It is the most precious element which man can use or abuse in the development and progress of mankind.

It is so precious that not a moment must be wasted in making the most of our opportunities.

Are we all quite satisfied that we make the fullest and most profitable use of the time available?

Do we, in fact, give as much attention to the most economic use of time as we do to the economic use of materials.

The purpose of this Paper is to, on the one hand, stimulate thought and discussion on this question, and, on the other hand, to indicate possible improvements in the use of time in Industry.

Agreed that at some time or other the question of 'time' registers in our minds as a most vital factor, but this far too frequently is given the maximum attention too late in the scheme of things.

How often do we hear such expressions as—"If only I had thought of it in time," or "If I had only had the time," or "If I had my time again."

It will be agreed that sayings such as these create that most miserable and depressing feeling that we are "*too late*."

"The hour has passed, the door is closed, you are too late"; can one conjure up a more gloomy outlook than this, and yet it is happening every day and will continue to happen, unless the full and necessary importance is given to the "Time" factor at the right time.

The specific subject under review and as applied to industry refers to the period when a Production Policy has been agreed, to the time when that policy is put into full operation.

It can be safely assumed that Production Engineers are genuinely time conscious, and that most careful and scientific application is made in analysing the minimum production time factor: we even go to the extent of taking photographs of spot lights attached to the operator's hands, etc., in order to ascertain the shortest possible operating time.

It is therefore not this aspect of 'time,' *i.e.*, operating time, which is under review, and in order to clear this point, a parallel is given, namely, it is not the time from when the pistol is fired at the starting point to the time that the runner breaks the tape, but the basic question as to whether the runner is ready and prepared on the field for when the pistol is fired.

Some reference will be made to the period of time which elapses before a Production Policy is settled, as this period also needs some investigation.

---

What, in any case, causes a Production Policy to be even discussed?

Assuming that industry exists to satisfy the needs and well-being of the human races, then what is the prime mover?

Either a dire necessity automatically creating a demand, such as, food, clothing, houses, etc. (to satisfy the first elemental needs of nature) or the results of Market Research, in order to create a demand so as to improve the standard of living.

These are two broad references, but to those who are responsible for industry and its development, then it is equally their responsibility to be alive to and in touch with these needs and demands, so as to competently frame a Production Policy in the knowledge that this will have a good measure of success and general benefit.

There is also the important factor of the Nation's needs in order that the national development should not lag behind other progressive Nations.

This subject will require very much closer study and support than it has so far received, as it will serve little purpose to produce unnecessary trash against quality goods to serve the genuine and fundamental needs for progressive well-being.

### **The Problem.**

What, therefore, are the main phases through which industry has to pass to satisfy a need.

Firstly, there is Market Research and general basic Technical Research: from these two main factors we solve the equation of Problem = Solution, *i.e.*,  $X = \text{Production Policy}$ .

Setting out the main phases in industry following the laying down of a Production Policy, these, for illustration, may be quoted broadly as follows:—

- (a) Specific and local Research and Development.
- (b) Preliminary designs.
- (c) Experimental work.
- (d) Design for Production, including the establishment of standard costs.
- (e) Issue of drawings and specifications.

## THE TIME FACTOR IN INDUSTRY

- (f) Technical Buying, namely, raw material and finished parts to specification and standard costs.
- (g) Planning, namely, Works layout, plant, methods, design of jigs, tools and gauges, and cost estimating to standard costs.
- (h) Specification and ordering of this production equipment.
- (i) Progressing of supplies, i.e., Material Control.
- (j) Progressing of plant and equipment.
- (k) Prototype production.

It should be mentioned here that under the brief heading of Technical Buying, all the factors quoted from (a) to (k) have to be dealt with in part, or whole, by all suppliers and sub-contractors.

This means that each and every supplier, if he is to be efficient in his undertakings, has to consider and give time to each of these factors.

Whatever the product is of the parent Company, be it aeroplanes, marine engines, motor cars or steam rollers, one of the largest factors to be considered by the parent Company is, and should be, the Bought-Out items. (See Fig. 1).

Also under the heading of Planning most of the factors quoted from (a) to (k) are involved in connection with the supply of plant, machine tools, jigs, tools and gauges, etc.

### Normal Approach to the General Problem.

Taking the pre-production period, namely, of Market Research and settling production policies, these broadly are divided under two headings :—

- (a) Speculation by the Parent Company.
- (b) Enquiry by the Sub-Contractor.

Parent Companies quite frequently wait for someone else to make the first move and then follow in a hectic rush to catch up, sometimes benefiting by the pioneer's experience, and later forming Groups or Associations with other similar Parent Companies for the purpose of settling certain policies covering such factors as selling, export, etc.

Sub-Contractors hearing at a later date of the speculative moves of Parent Companies, send out their enquiries as to whether they can participate in some form in the main project.

Advertisements are resorted to, much personal contact and previous goodwill play an important part in whether or not the sub-contractor obtains an order.

The sub-contractor quite frequently is kept 'dangling' for months until a final decision is given.

## THE INSTITUTION OF PRODUCTION ENGINEERS

Are we quite satisfied that sufficient time is given at this stage to general consultation or pre-planning?

Is it not felt that Production Policies are kept too close—a secret known only to a local few—possibly causing rumour to spread in an undesirable form.

Much time is spent and lost at this stage in what might be termed in the racing code as "Jockeying for position."

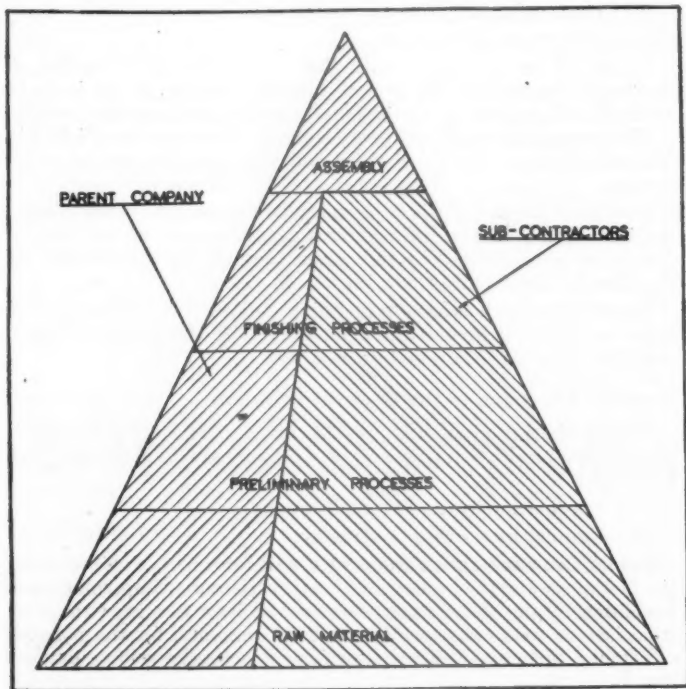


Fig. 1.

All Parent Companies and Contractors are dependent upon their main sub-contractors, and it is thought that much time could be saved by general and early Policy Conferences.

There are, of course, many notable exceptions to this in this country, but generally speaking pre-planning is given insufficient attention.

### **Normal Approach to the Factory Problem.**

Turning now to the subject under review and following a Production Policy, which presumes to be set, what is the normal run of things? The following approximates to this:—

#### **Specific Research and Development.**

This Section is usually regarded as "Strictly Private and Confidential": "No Admittance" is frequently written or implied. Very little is known in the Factory as to what is coming out next, or when.

#### **Preliminary Design—Experimental.**

These Sections also are usually regarded as strictly private and confidential, with very limited knowledge in the factory as to the new developments.

#### **Drawing Office, Buying and Planning Departments.**

Here again admittance is usually only by infrequent invitation.

Departmental isolation resulting in Departmental correspondence is apparent with an element of criticism in the air.

Drawing and specifications are subsequently issued to the Buying and Planning Departments.

These drawings and specifications have been carefully drawn up, standards of finish and limits applied, in fact, everything is 'all set to go.'

Then the 'fun' commences, the Buyer sends out his drawings to known suppliers of specific items for alternative quotations, but by this time Planning have been busy and suggestions and queries begin to go back to the Designs Department.

Major or minor suggestions are made, namely, parts specified as machined stampings, the query is raised why not die-castings, open pressings, two half-pressings flash butt welded, etc., etc.

Parts specified as machined castings: why not die-castings, or fabricated assemblies, etc., etc.

Main suppliers of castings, stampings, etc., are called in to discuss with Planning datum locating points or faces, machining allowances are established, etc. etc.

The Buyer also takes a turn and suggests that if a certain item was specified in another material, or certain other modifications were incorporated, he could more easily achieve the target costs.

Sub-contractors begin to send in queries and suggested modifications to facilitate production.

Planning then follows up with a second wave of queries, having carried out the basic process planning; queries on limits, standards

of finish, modifications to assist production, also flow-back to the Designs Department.

Designs Department then becomes busy again honestly trying to incorporate many suggestions to either improve the product or reduce costs, or both, and then the modifications begin to flow out again through the Buying and Planning Departments.

Often by this time, the Experimental Department has had another "think" and even better results are found by this or that modification.

Jigs, tools and gauges designed or partly made have to be recalled, modified, etc., etc.

A good suggestion from the Planning Department or the Buying Department, from a supplier comes too late, insufficient time is available to incorporate a very desirable feature.

The expenditure estimates have to be approved and sanctioned. These estimates have to be carefully drawn up for presentation, and if considered to be excessive, are curtailed, thus affecting methods, probably involving partial re-planning.

These estimates are usually hurriedly compiled having a large margin of safety to cover any unforeseen circumstances arising subsequently.

By this time there is a note of urgency in the air, and discreet and well-meant enquiries are made by the Senior Executives, and a halt is called to any further modifications.

The first real pressure is applied and the word 'Urgent' finds its way on to the paperwork.

Whilst all this very competent and necessary work is going on, time is passing.

Then follows Prototype Production, proving and trying out equipment and first samples, etc., and once more further enquiries and suggestions come back to the Main Departments, but this time up three avenues, namely :—

- (i) To Designs Department regarding the actual product.
- (ii) To Planning Department regarding the equipment and methods, etc.
- (iii) To Buying Department regarding the Bought-Out Items.

Many of these suggestions, of necessity, have to be incorporated, as they are found by production practice to be essential.

About this time a further enquiry is made by the Senior Executives, but this is now less discreet and polite; in fact, an important conference is called of all Production Officials and certain final target dates are laid down, and so the final intensive pressure is applied causing short cuts, temporary methods, hand methods, etc., to be adopted on those items in arrears.

The Works Staff, both at the Parent Company and sub-contract-

## THE TIME FACTOR IN INDUSTRY

tors, are now at full pressure ; Inspection Department is now taking a hand in establishing standards, temporary piecework prices are fixed, and so on.

Coats are off, the fight against time is on.

The product commences to come out (or not, as the case may be) on time.

Although production in some form has commenced, there is much more yet to be done in eliminating temporary methods and tempor-

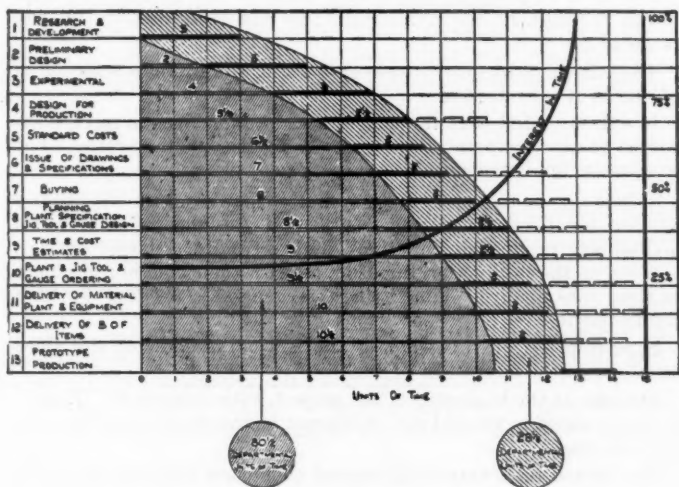


Fig. 2.

ary piecework prices, and even this important clearing up process very often has to take second place to production.

By reference to Fig. 2, an attempt has been made to show graphically how the normal time factor is absorbed.

It would be impossible to lay down any standard chart on this subject, but the one shown on Fig. 2 will serve the purpose of general illustration.

The Departmental functions are listed against the vertical line and units of time shown along the horizontal line.

A bar is plotted against each function showing units of time for each function to complete its work.

It will be noted that each of these bars representing function time, overlaps the previous function indicating recognition of the 'Time' factor, that is to say, that we have at least passed the age

when everything has to be finished at one stage before passing on to the next.

Figures are quoted against each function showing the period of time from when the Production Policy is settled and Research commences, to when each particular Department commences to operate on the particular project.

The area exposed on the graph for the delayed pick-up period shows  $80\frac{1}{2}$  units of Departmental Time not absorbed.

The area exposed on the graph between the two action lines shows  $28\frac{1}{2}$  units of Departmental Time absorbed directly on the project.

The total length of the project embracing all functions is shown as  $12\frac{1}{2}$  units of calendar time.

It will be noted that the curve of the action lines is more horizontal at the beginning, but tends to become more vertical as it reaches its final stages.

This is due to two main factors, firstly, that more time is usually allowed for Research, Experimental and Designed, than for the preliminary production functions, and, secondly, a larger overlap is given to the production function, as with their common problem in their race against 'Time,' there is generally a closer working arrangement.

Superimposed on this whole graph is a curve showing the more usual rise in the interest in 'Time.'

Starting at the beginning of the project, little interest in "Time" is taken, showing a rapid rise in interest as the project reaches production stages.

The dotted lines extending beyond the action lines are shown to indicate the 'Tidying up' period, until production is really in full swing, but temporary and hastily conceived methods have a nasty habit of carrying on, sometimes to the end of a contract.

It is felt that the foregoing is a fairly general illustration of things as they are to-day, on average.

No attempt has been made to exaggerate but a genuine attempt has been made to be frank and honest.

Very few will deny that this brief description of things as they are is on average a reasonably true picture.

There may be many who will say that too optimistic a picture has been painted: be that as it may, suffices to say that the general illustration given is the background from which the development of the subject under review can be taken and give sufficient scope to illustrate the original contention, that insufficient attention is given to the time factor.

### Suggested Approach to the Problem.

Now let us turn to a positive and more progressive outlook and endeavour to expose the possible lines which may be followed.

The responsibility placed upon those in charge of industry is growing, growing to a point where individual gain must not remain the only reason why we are in business, and it is suggested that a much broader and national outlook should be maintained.

Reviewing once again the phase up to the setting of a Production Policy, what can be done to save much of this initial time.

Whilst it is known that established Associations do to some extent frame their policies ahead, do they discuss these policies sufficiently with all interested parties, including the Government Department concerned.

This is not mentioned just because of war, or the change from war to peace, but should apply at all times, as surely there should be a very close connection between progressive industry and progressive Government.

It has been said that had we, as a Nation, looked far enough ahead and used the time available to the best advantage, we should have been more prepared for the present war, in fact, may never have been at war at all.

To quote one example, namely, Export : much has been heard about the importance of export, needed for the very existence of these Islands, but is there yet a clear planned joint policy and does industry yet know what part it has to play.

Is it again going to be left to the individual industry to find its own way, or is there really going to be a plan of five, ten or twenty years ?

We have seen the successful results of National plans, and surely it is better for all concerned to have an underlying and consistent plan than to all go our own several ways for say a period of twenty years, and then have to face for a period of five or six years the most intensive and revolutionary National plan, namely, war.

Enormous savings could be made in time, progress, materials and men if we acquire the habit of a united future Plan.

So also domestically could Associations and Technical Groups discuss and rationalize their particular products, which, in turn, would lead to a more specialised approach to the solution of our problems.

It should be made clear that this reference makes no suggestion as to individual enterprise competing with Nationalization, but if either fails to solve a National problem, then the other or both must help.

The time spent on framing the solution to a need or want, surely can be cut down if there is a greater unity of purpose, as industry

often stands like a "Bear in a pit" waiting to see who will throw the first bun or brick and from what direction.

It is felt that both nationally and industrially that if we are to be really competitive, we must get off the mark both quicker and better, but unless we have well laid plans before us, we may never even hear the "Starter's Pistol."

Turning to industry itself and again asking the question, "Can we produce a quality product economically and pass it to the market quicker?" It is felt that the answer to this question is "Yes."

What then is the first basic approach?

In the very first instance those controlling industry will have a greater interest in the Time Factor at the very beginning of the project.

Right at the research and experimental stage, all those interested in the subsequent stages must be called in, and included in this invitation must be the specialist sub-contractors or suppliers.

Inspection, Buying, Planning and Production should come in right at the very beginning.

They should be acquainted with the basic Production Policy, i.e., what is the proposed project, the quantity in total and rate, and the market in which the product is to sell, namely, quality or cost, or both.

The objective dates should be broadly disclosed and freedom to express views should be allowed.

This type of conference should be one of explanation so that all concerned foster a united spirit as part of the scheme, and all would feel members of a team endeavouring to reach a common goal.

A second conference should be called after the first main research and experimental work has been carried out, and basic suggestions should be tabled and discussed, as Buying, Planning and Production, including specialist sub-contractors would by that time have had an opportunity of giving thought to the problem.

A series of preliminary investigations would have been carried out and a component part normally specified as a machined stamping, would be considered as a pressing, die-casting, etc., etc.

Relative merits of more advanced practices could be investigated and the specialist firms would supply data based on their own specialized research and experiment.

Cost targets would also be established.

This early investigation by all concerned would have a very marked effect on the Time Factor, as by adopting a more modern and more scientific process, all unnecessary time of planning, jig and tool design, estimating and plant specification would be eliminated; also the Buyer would have time to obtain cost estimates of the very latest practices.

Where special or unusual plant was known to be involved, Planning Department would be putting out preliminary enquiries and also study the best technical solution, at the same time building up a preliminary estimate of plant and equipment costs for early presentation.

Where extreme limits of accuracy and surface finish are required, the same forward enquiry and study action would be taken.

Buyers, instead of bargaining to knock 10% off the price of a normal article, may find that a new and different technique would give them a satisfactory article at a quarter the price.

A great deal of this work would be done by only knowing what the project was, and what market was to be catered for.

Suggestions would be coming in at a time when the design and specification was flexible with the result that the Design and Research Department would welcome these suggestions at that stage, whereas at a later stage these same suggestions would be regarded as a nuisance.

There would be a better spirit of adventure and enthusiasm amongst all concerned.

Possibly, above all these points would be the study by Planning and Buying of the long term items, leading to the early establishment of a priority schedule calling for designs of long term items first.

This, in turn, would allow for forward planning, either in the Parent Company or main sub-contractors, and press tools, dies, jigs, tools and gauges, patterns, etc., could be put in hand months before the short term items were finally specified.

It is only the Buyer or Production Engineer who can advise on these long term jobs.

They know their problems and those of the suppliers, and consequently could be anticipating and studying the pitfalls, and finding the solutions if they were acquainted with the Production Policy at the earliest possible moment.

If technical buying is to replace the old-fashioned bargaining system, then there need be little fear of failure, as target costs would be established and a background of technical data available to support these target costs.

Incidentally, it is hoped that the price of an article in the future will not depend upon low earnings so much as upon modern production methods, allowing a good standard of living on the one hand, with articles sold at a competitive unit cost.

The knife and fork are expensive tools compared with a modern piece of machinery, even if the labour cost per hour is halved, but modern production methods depend more and more on ingenious and accurate plant, intricate tools, dies, jigs, and gauges, and if we are going to use modern methods, then we must allow full and pro-

per time for their introduction and manufacture by the skilled craftsmen.

All this can be done if an appreciation of the time factor is in evidence at the beginning of a project.

Exactly the same policy of joint conference should be adopted by the Planning function, as they in their turn should build up the enthusiasm of the factory by calling in at the earliest possible moment those who will ultimately have the responsibility of production.

Much practical advice would be available to the Planning Engineer. Many valuable suggestions would be tabled, and all, in any case, would feel that they were interested parties in the project.

This again would avoid many of the delays during the proving stage and would, in turn, establish the priority of plant and equipment, so that proving of a tricky and difficult job is cleared in the early stages.

In the same way, should Inspection be called in at the earliest possible moment to establish basic systems of gauging, datum faces, etc., so that methods of production were planned with this knowledge in mind.

The experience of the skilled and key workpeople should be invited also as early as possible, as they, too, should be given some preliminary information regarding the new project or scheme.

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As a Nation built up of individualists with democratic views and free speech, there is a popular reference made decrying Committees and Conferences.

How frequently is heard the saying "I object to committees except a committee of one, namely, myself," but it is interesting to study the result of a large project which started with a committee of one, as this more frequently than not finishes up with fully attended and frequent committees, with terms of reference such as "How can we save the situation?" or when the situation is lost "Whose fault was it?"

Why not be quite frank about this whole question of committees and conferences, as the evidence is available to show that we do, in fact, hold a considerable number of conferences and committees and have been doing so for many years.

It will also be generally accepted that the majority of these conferences have as their agenda the progressing of projects, and far too many have to give time to what may be termed "Snatching the chestnuts out of the fire" conferences, last minute emergency methods, etc., or finally "finding the scapegoat."

Surely it is better to give this same time, or even less, to pre-planning objectives, conferences of explanation to all functions

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concerned and give the greatest possible attention and interest to the time factor at the very beginning, so spending conference time on a positive and creative note rather than to the more negative note of censure, criticism, and use of the thick stick towards the end of the project.

Here again, an attempt has been made to illustrate savings in time by approaching the matter in the more positive way (see Fig. 3).

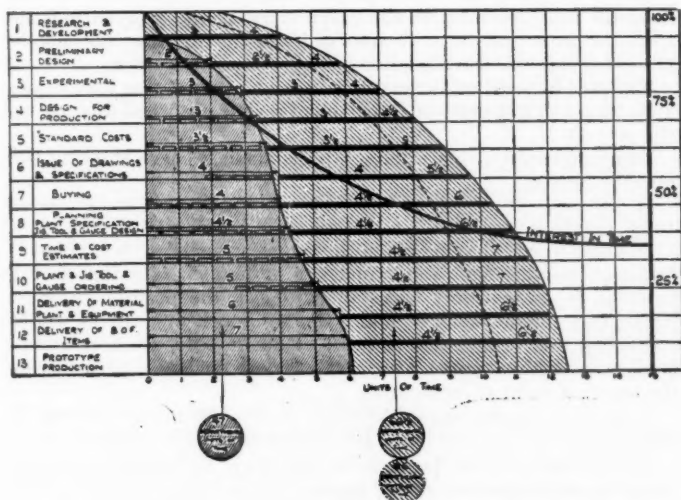


Fig. 3.

The same departmental functions are listed against the vertical line and the same units of time are shown along the horizontal line.

A bar is plotted against each function showing a longer unit of time for each.

It is felt that much more time should be allowed for Research and Development Experimental work and design work, and this refers not only in regard to the actual product, but to methods, equipment, etc.

The dotted bars on this illustration are shown at the beginning indicating that all functions have been called in right from the start.

It will also be noted that a considerably greater overlap has been allowed between one function and another indicating a much closer unity of working and purpose, as all functions know the main

features of the project and therefore can create by knowing the common objective, a better departmental working harmony.

With this early knowledge, it will be seen that the first direct action line commences earlier and takes a more vertical position on the graph, as all functions are "Getting off the mark" much closer together.

There is also a compounding of activity which, in turn, keeps all concerned "On their toes."

It will be noted that with a project taking the same total units of calendar time, the area on the graph showing the delayed pick-up time has been reduced to 47 units of Departmental time not wholly absorbed, but still usefully absorbed by preliminary work.

The area exposed on the graph between the two action lines shows an increase to 66½ units of Departmental time absorbed directly on the project.

Superimposed on this whole graph is again a curve showing the *interest in time*.

It will now be observed that this time interest commences at 100% and falls towards the commencing of production.

In other words: having given the proper interest to the "Time" factor at the right time and launched a project with the time factor in mind, it is then only necessary to check the position prior to production commencing, as under this approach first things would come first and last things last, all fitting in to a pre-determined pattern, ready in planned form, and correlated one with the other at the starting point of production.

It needs to be emphasized that it is at the beginning of a project that the greatest interest in the time factor should be displayed.

By approaching the problem in this way, by careful studying and planning of the best use of time, if this is done, down come the Departmental "brick walls" in the interest of the scheme as a whole.

"That which advantages not the hive advantages not the bee."

*Marcus Aurelius.*

Time-saving objectives are set with everyone willing and anxious to make suggestions which will save time.

It will also be noted on the illustration that no dotted bars are shown after production has commenced, as sufficient time has been found within the same calendar period to do first things first and to have everything complete before production commences.

This has a lasting and beneficial effect on the product and on the subsequent production: the plant, tools and equipment are ready, and tried out and proved; the flow of material comes through the stages in good order; permanent piecework prices are fixed and volume output reaches its peak production as planned.

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Bought out materials and components are available to meet the production schedule and also coming into agreed objective costs, and over all the project an even distribution of the load has been made on the technical and organising staffs, both at the Parent Company and at the sub-contractors.

It is frequently said that in this country we have no time or cannot afford to pre-plan, but the principles set out in the foregoing references are even more necessary, if the time and/or money are short.

Surely it is logical to ration commodities in short supply and pre-plan their best and most useful application.

By reference to the graph (Fig. 3), this point has also been illustrated, as the middle action dotted line shows that units of calendar time can be saved and still give 46 units of Departmental time to direct action.

Competition will demand that production gets "off the mark" quicker and better, and this, it is felt, will be greatly assisted by applying the broad principles previously enumerated, and although nationally we are excellent at fighting our way out of a corner, one naturally asks "Why do we need to be in a corner at all?" as in most cases this can be avoided by pre-planning and an early study of the "Time" factor.

Whilst it may be heroic to fight our way out of a corner, we must seriously ask ourselves the question, is this habit going to keep us internationally competitive.

It is said that to forecast the future a careful review of the past should be made and many of the main points mentioned can be proved beyond doubt, by carrying out an inquest on any particular project which has been completed.

If the starting and finishing dates of actual events are plotted as they have happened, and then quietly studied to see if better and more profitable use could have been made of the time, in most cases it will be quickly revealed that time has been unnecessarily lost.

It would be foolish to suppose that this subject be covered by any set of rules or formulae covering the many aspects of industry, but it is claimed that by keeping the question of time well in mind, particularly, in the early stages, first things will be dealt with first, long-dated items will be given special treatment and many of our problems which are to come will be dealt with more logically and efficiently.

Let us now apply these principles to a few everyday problems and so stimulate the question as to whether there is any room for improvement in many of our more detail problems.

To quote certain examples :—

### **Machine Tool Repair.**

A machine tool, or an important piece of plant has broken down, and assuming that the minimum length of time to repair the machine tool is one week, the first question which should be raised by the Maintenance Engineer is "What else can be done to the machine, at the same time, whilst it is down?"

A quick general inspection will probably bring to light a number of small repairs which can all be dealt with within the same time as the major repair, and working on the sound principle that "A stitch in time saves nine," such action will probably prevent a further major breakdown.

It is not, however, unusual to find that it is only the specific breakdown job which receives attention, with the result that a series of repairs is carried out in a year, not only causing a machine tool to be on the 'sick list' for a longer period, but much time is wasted in re-stripping and re-assembling, which had already been done on the first major breakdown.

This is a very important matter as each square foot of factory space is valuable, and no plant should occupy space unless it yields a proper return.

Some very interesting information is found by plotting periods of breakdown (particularly on key machines) to see how many periods of breakdown could have been saved by taking full advantage of the first major breakdown.

Another example :—

### **Machine Tool and Plant Replacement.**

How much time is wasted up to the point of ordering the replacement plant, and how much time is allowed for the supply of the replacement.

This question of keeping machine tools and plant up to a correct standard is vital to the efficient progress of industry.

Whilst financially, depreciation is automatically allowed for each year, what is the physical position? Gradual, or rapid obsolescence of plant either by age, or method is continually going on, time is taking its toll, in most cases, automatically.

Believing it to be an important part of good Works Management, there should always be before the Directors at least an annual review and a clear and frank statement as to the condition of the Company's plant, with the suggested overhaul and replacement programme clearly stated covering twelve months at least.

With such a forward programme sanctioned early, time is allowed to all concerned to pre-plan for this work of overhaul and replace-

## THE TIME FACTOR IN INDUSTRY

ment, thus allowing the Plant Engineer to study the best and most up-to-date replacements.

Time is allowed to the makers of the plant and again the same basic principle is applied, namely, making the best use of the time available.

Last minute emergency rushes caused by a faithful but disregarded machine 'giving up the ghost,' the purchase of the replacement plant or machines is made, such plant often not entirely suitable and sometimes very costly, just because that particular piece of plant happens to be in stock.

Quoting another example :—

### Factory Building and Road Development.

Working on the logic that the Factory buildings and roads are just as important as the plant they contain, and should in consequence be included in the planned production unit, what is the usual approach to this question ?

A factory is planned and built and in many cases to-day the production executives have an opportunity of expressing their opinions on the general layout, proportions, road widths and surface, etc.

The factory is built and production commences, increases and increases, and it is more often than not that there is a late realisation that more room is required.

There is usually little or no time for careful study of development of land, roads or buildings, production has first call and extensions are hurriedly constructed, "Lean-to's," and sheds are put up against existing walls and main roadways are encroached upon.

At a later date when sound development has taken place, many of these hurriedly erected temporary buildings are pulled down again (or not as the case may be). This subject offers more scope than most for pre-planning, and where this question of time is fully understood, plans are made well in advance for logical development.

It is recommended to always have available two models :—

- (1) The factory as it is to-day, and
- (2) The factory as it should be extended, including the ideal extensions which can be contemplated.

With such models available and by giving the necessary time in the early stages, pre-planning of the next step in the expansion can be laid down.

Study almost any Works of 20 or 30 years of age and see how extensions have been literally 'stuck on,' leaving in many cases, an unfortunate legacy for the next generation.

If future extensions are pre-planned, which can be done to anticipate the next move, the ground can be levelled, footings struck, an area concreted ready to be covered, etc.; as part of a preconceived plan which again makes the best use of the time available.

To quote one more example, and probably the most important one of all, namely :—

### **Factory Personnel.**

If it is sound to pre-plan the replacement of Plant and the extension of buildings, so also is it sound logic to pre-plan the replacement and extension of personnel.

This question is probably the most important national work which can be pre-planned, as since the human factor is the prime mover from which good craftsmen and sound technicians are trained and developed, if this training is given at the right time, then efficient progress must follow, as the human being is the most important factor in industry.

Keeping the time factor well in mind and pre-planning for the future key men, is one of the best uses to which time should be given.

In looking ahead, it is clear that there will be the greatest possible need for fully qualified men, but we must not wait until the last minute when the demand is upon us, or assume that some unknown Good Samaritan will provide the qualified men, but to lay down early plans in anticipation.

### **Conclusion.**

If it is found that all one's time has to be given to dealing with the urgencies of the present and the delays of the past, then obviously insufficient time can be given to the future, but by making the best use of the present, so do we anticipate the future and leave a record behind of time well spent.

Much that has been said in the foregoing will clearly call for competent criticism, but so long as these writings have stimulated thought of the best use to which time can be put, then the purpose of these writings will have been served.

"Bethink thee how long thou hast delayed to do these things ; how many days of grace heaven hath vouchsafed thee and thou neglected. Now is the time to learn at last what is the nature of the universe whereof thou art part ; what of the power that governs the universe, whereof thou art an emanation. Forget not there is a boundary set to thy time, and that if thou use it not to uncloud thy soul it will soon be gone, and thou with it, never to return again."

—*Marcus Aurelius.*

## PRODUCTION ENGINEERING ABSTRACTS

### Research Department : Production Engineering Abstracts

(Prepared by the Research Department.)

NOTE.—The Addresses of the publications referred to in these Abstracts can be obtained on application to the Research Department, Loughborough College, Loughborough. Readers applying for information regarding any abstract should give full particulars printed at the head of that abstract including the name and date of the periodical.

#### ELECTRICITY, ELECTRICAL ENGINEERING.

**Electronics in Industry**, by J. H. Reyner. (*Aircraft Production*, April, 1945, Vol. VII, No. 78, p. 155, 8 figs.).

The comparatively new technique of Electronics is beginning to play a more important part in the aircraft industry, and its applications are increasing as the subject becomes more widely known. This article explains a few of the innumerable applications, and a bibliography of previous articles is given. The applications include : strain and vibration gauging, dynamic balancing and gauging equipment for electrical assembly lines.

#### EMPLOYEES, ETC.

**Plan for Reinstatement**. (*Industrial Welfare*, March-April, 1945, Vol. XXVII, No. 299, p. 37).

The object of these notes is to assist in planning the reinstatement and resettlement of service men and women in civilian occupations on their release from the Forces. All firms have to face this problem and many are well ahead with plans for the absorption of service employees. The present aim is to make some of these plans more widely known, and to offer information and suggestions which may be helpful. The background is provided by the training and resettlement plans put forward by the Ministry of Labour and National Service, and the three Fighting Services. These plans are summarised. The official arrangements for the employment of the disabled are not yet complete and they are, therefore, only briefly dealt with.

#### FOUNDRY.

**Maintaining Casting Quality**, by S. A. Inscoc. (*Mechanical World*, 20th April, 1945, Vol. 117, No. 3042, p. 427, 10 figs.).

Inspection of sand, gravity and pressure die castings, in light alloys and zinc base alloys has to be rigorous in the extreme in order to eliminate at the very earliest stages faults in production of quality and soundness. Apart from dimensional errors, defects in castings may be cracks or porosity, and for castings which have to resist pressure, leakage under test is the chief reason for rejection. Detection of such cracks, porosity, and patches of sponginess in castings is therefore a matter for the very closest attention. Visual critical inspection, pressure testing, and X-ray examination, or some combination of these are now regularly employed. Large diameter magnifying lenses of high quality optical glass are used extensively for critical inspection of castings. The use of stationary and portable X-ray equipment in the inspection of mass-produced

## PRODUCTION ENGINEERING ABSTRACTS

castings is now considerable and is likely to be still further developed. Light metals are easily penetrated by X-rays, and as the rays also affect photographic plates and films, it is thus possible for a radiograph or shadow photograph to be taken. By using X rays in conjunction with the fluorescent screen, single castings or batches can be more rapidly examined. A method of detecting cracks and areas of porosity still extensively employed, is to submerge castings in a warm mixture of paraffin and lard oil. Castings are allowed to dry and then dusted with powdered french chalk. Any oil still retained in cracks and pockets of porosity will then impregnate the chalk and defects will be clearly defined. Light alloy castings can also be inspected in bulk on the principle of sink or float, liquids of suitable high specific gravity being employed. Recent developments in inspecting for cracks and porosity make use of proprietary fluorescent solutions and the properties of ultra-violet light. Two solutions are used, the first being a fluorescent solution of extremely low surface tension, and the second a washing solution. Articles are first immersed for a few minutes in the fluorescent solution, this being allowed time to penetrate wherever it will. The parts are allowed to drain and dry off, and are then rinsed in the washing solution to remove fluorescent material from the surface. When dry, castings are held and turned about beneath a mercury vapour lamp which is fitted with a special reflector and a filter to exclude all visible light. Because the fluorescent material still remains in all cracks, pinholes and pockets of porosity and tends to seep out, this is shown up under the ultra-violet light in vivid green lines and areas. Flaws too fine for ordinary visual detection are thus revealed. Considerable advances have recently been made with the use of electrical apparatus in the examination of components made from both ferrous and non-ferrous materials. Methods employing magnetic induction depend upon the fact that the apparent resistance of a coil which surrounds a standard specimen and is fed with high frequency alternating current varies with the dimensions and electrical conductivity of such standard. Suitable more especially for use on bars, tubes and work of constant cross section, this method can also be successfully applied to fabricated work and castings, especially in the case of castings produced from permanent moulds. The radio frequency crack detector has been found efficacious on material up to six inches diameter, and with the provision of necessary equipment in the way of suitable coils will be effective on mass-produced castings and stampings. Cracks or defects in the surface restrict the flow of current, and the impedance of the measuring surface is changed. The presence of such cracks is indicated on a small viewing panel, while on some instruments both the position and the extent of the crack can be obtained.

## GEARING.

**Gear Cutting**, by A. S. Rowley. (*Power Transmission*, 15th April, 1945, Vol. 14, No. 159, p. 244.).

The simplest and most versatile form of gear cutter is the universal milling machine. Besides spurs, spirals and racks, worm wheels and bevels, which are sufficiently accurate for many purposes, together with elliptical and other special gears can also be cut, granted the necessary skill and experience. The method for milling spiral gears is described, and notes are given on differential indexing and climb milling. Theoretically, a different cutter would be required for every number of teeth cut, but in practice a range of eight cutters for each pitch has been found to give sufficiently accurate results for general requirements. Hence a gear cut with a rotary cutter will not mesh satisfactorily with another which has been produced on a generating machine. The Brown and Sharpe automatic gear cutter is the logical development of the

## PRODUCTION ENGINEERING ABSTRACTS

standard milling machine. Many engineers consider that this design is the best gear cutter yet produced. Its most obvious drawbacks are that when cutting spurs eight cutters are required for each pitch, and the quality of the gear produced is entirely dependent on the accuracy of the cutter used. The majority of gears are now produced on "gear-generating" machines, in which the blank rotates continuously and uniformly throughout the whole cutting operation, while the cutter moves in pitch with it, like two gears in mesh with each other. As a spur gear will mesh or roll with a pinion, rack, or worm of the same pitch, so spur teeth can be generated by cutters of these three types, or a rack may be generated by a pinion or worm cutter, and a worm by a pinion or rack cutter. By generating, the exact tooth form is produced whatever the number of teeth in the gear, and it is possible to avoid undercut by making the blank diameter larger than standard. In the author's opinion this latter factor is often over-emphasised, as the same result can be obtained without departing from standard diameters or centres, by simply increasing the pressure angle of the tooth. The original generating machine using a pinion cutter is the Fellows gear shaper, and the rack form of cutter is used on the Sunderland and Maag gear planers, while the worm form of cutter is used on all hobbing machines. The principles of these machines are briefly indicated and their relative merits are compared with the aid of a table. Worm wheels are generally cut with a hob, the action being similar to that described for spur cutting except that the hob is set in line with the centre of the wheel face and is fed in either radially or tangentially; in the latter case a taper hob is generally used. Of these alternatives, the former is the quicker method, as it allows more hob teeth to be continually in engagement with the blank, while the latter is the more accurate, especially when using multi-start hobs. When a suitable hob is not available worm wheels are generated with a "fly" cutter. For quantity production worms are generally cut on a thread milling machine, which in principle may be described as a screw-cutting lathe with the cutter head mounted at the back of the cross-slide. While a single-thread worm is completed in one traverse it is necessary to wind back, index, and cut another space for every additional thread of a multi-start worm. For comparatively small pitch worms these operations can be eliminated by generating the threads with a pinion type cutter, the process being the converse of hobbing in which the worm generates the wheel. The author has cut various multi-start worms on a Reinecker universal hobbing machine by mounting a Fellows cutter on the normal work arbor and the worm blanks on the hob arbor. For general work, as distinct from quantity production, the author still prefers the old-fashioned method of cutting worm-threads on a suitably designed screw-cutting lathe. Most racks are cut on milling machines. If long racks are required a universal head, designed with the cutter spindle along instead of across the table, is essential. The majority of automatic rack cutters follow the milling-machine principle. The simplest form of bevel gear planer is the old Gleason single tool design. The Gleason bevel generator is generally accepted as pre-eminent when mass production is the objective, but when the quantities are not so great and ease of setting up becomes a factor, the Robey-Smith bevel planer has much to recommend it.

*[An abstract of the same paper (originally read before the Manchester Association of Engineers) also appeared in Machine Shop Magazine, April, 1945].*

**Current Practice in Marine Gearcutting**, by A. W. Davis. (*Transactions of The Institution of Engineers and Shipbuilders in Scotland*, March, 1945, Vol. 88, Part 5, p. 179, 9 figs.).

The general lines on which progress is being made can be divided under the following headings: 1. Gear layout design. 2. Gear tooth design. 3. Pre-

## PRODUCTION ENGINEERING ABSTRACTS

cision in gearcutting. 4. Improvement of tooth surfaces by post-hobbing processes. 5. Gear measurement. The layout of double-reduction gears is discussed and comparisons are made between British and American practice. In gear-tooth design, practice in this country has, up to the present time, stabilized on 30° helical angle, but in the United States angles from 18° to 45° have been used according to circumstances. It is considered that insufficient attention has been given in the past to the possibilities of teeth greater in depth relative to pitch than the B.S. form, and considerable benefit should be obtained by taking advantage of the greatest increase possible. Suggestions for modifications to flank angle and the distribution of addendum are also made in the light of current British and American practice. The principal hobbing machine errors and the corresponding defects which they introduce in the work gear are shown in a table, and full comments are given. The author expresses the opinion that facilities existing in this country at the present time for the production of high quality wormwheels are of such an inferior standard that reversion to solid table drive for gear hobbing machines would be both premature and unfortunate. The various errors that in some degree are inseparable from gear hobbing introduce surface errors on the gear teeth that ultimately can only be eliminated by some other process. Current practice in such post-hobbing processes may be broadly classified as skilled handwork on the teeth, lapping with abrasive, and shaving. The effectiveness of each of these systems, so far as the various hobbing errors are concerned, is shown in analytical form. The practice in the United States has differed from that in this country primarily as the skilled labour required for delicate handwork was not readily available, and latterly because the requirements for surface finish have become more stringent. The practice which has been generally adopted there is that of lapping with full-width cast iron wheels. The alternative process of shaving is now achieving considerable success in the United States, and under a similar operational technique will shortly be employed in this country. Although such an advance in the matter of gear accuracy has been made in the United States the measuring technique employed by the production shops there is definitely inferior to the best practice in this country, which is described. An interesting discussion on the paper is also reported.

**Controlling the Variables in the Production of Gears.** (*Mechanical World*, 13th April, 1945, Vol. 117, No. 3041, p. 399, 4 figs.).

Practical fundamentals regarding temperature, carburising compound and steel are discussed.

### JIGS AND FIXTURES.

**The Importance of Attention to Jig Details**, by H. Moore. (*Aircraft Engineering*, April, 1945, Vol. XVII, No. 124, p. 122).

Practical points in the design and use of drill jigs.

### LIGHTING.

**Lighting the Small Power Press**, by J. H. Nelson. (*Sheet Metal Industries*, April, 1945, Vol. 21, No. 216, p. 633, 4 figs.).

Careful study of many set-ups shows that it is important that the operator should be able to see the work well, and the lighting must be designed to enhance the speed of seeing. The provision of lighting to show up the surface quality of polished metal presents a number of difficulties, and in many cases the provision of really good seeing conditions is impracticable. In the

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case of the small power press, however, advantage may be taken of the fact that the work is completely surrounded and an almost ideal procedure may be followed. The design of the power press and the nature of the details to be seen make the use of a large low brightness source the most satisfactory method. These principles are exemplified in the example which is illustrated and described.

### MACHINE ELEMENTS, BEARINGS.

**Fluid Film Lubrication of Parallel Thrust Surfaces**, by A. Fogg. (*Power Transmission*, 15th April, 1945, Vol. 14, No. 159, p. 287, 3 figs.).

The apparently anomalous behaviour of plain, non-taper, thrust collars—which were found to carry high loads at high speeds with low friction—was observed during an investigation of various types of thrust bearings for a particular application. The required operating conditions were rather special and differed from usual engineering practice chiefly as regards the speed of the rotating member of the bearing, which was considerably higher, in terms of an angular velocity, than has been common for shafts subject to high thrust loads. This investigation was concerned with the determination of the load carrying capacity of existing types of thrust bearing, such as the Michell bearing, under the special operating conditions, and if possible, the development of other and simpler types. After establishing that a Michell type bearing performed satisfactorily at the high speeds, a systematic investigation of various modifications to a plain annulus was begun and it was soon apparent that loads of the same order of intensity could be carried on simple fixed pads. The surfaces of these pads had been made so that, when running, they would be parallel to the rotating surface and the inlet edges had been made as sharp as possible, in order to avoid any tendency to a taper "edge effect." All the usual geometrical requirements for the establishment of a fluid film were therefore absent but in spite of this, subsequent investigation has accumulated considerable circumstantial evidence in support of the view that fluid film conditions occur and a tentative theory explaining the behaviour is put forward in this paper. The investigation is continuing, partly to provide data for design purposes and also with the object of obtaining direct evidence, or otherwise, by pressure measurements in the oil film, of the fluid film conditions and verification of tentative theory. It may be pointed out that although these results were obtained under exceptional speed conditions, there seems to be good reason to assume that the general characteristic determined in this investigation may be applicable at low speeds.

### MACHINING, MACHINE TOOLS.

**British Machine Tools During the War**, by A. H. Lloyd. (*Machinery*, 5th April, 1945, Vol. 66, No. 1695, p. 381).

The annual lecture to the Graduates' Section of the Institution of Mechanical Engineers formed a useful general review of production and development during the war. Special attention was given to motor drives and negative-rake cutting.

**Negative-Rake Turning and Boring**, by George M. Jalma, Jr. [*Machinery*, (New York), January, 1945.]

The early use of carbide tools was primarily in the machining of cast iron and non-ferrous metals. Radical changes in design and operation of the tools have resulted from war-time requirements. The article deals with tools of the type employed in turning, boring and planing operations

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and it is pointed out that the application of negative-rake tools does not constitute a "cure-all" for machining problems. Horse-power of the machine must be adequate and much depends on the good judgment of the operator and his willingness to co-operate. Illustrated examples of machining are given with details of tool angles and other cutting data.

(Communicated by Machine Shop Magazine).

**Machining of Copper—Comparative Efficiency of Diamond and other Tools,** by P. Grodzinski. (*Metal Industry*, 15th December, 1944, Vol. 65, pp. 373-376).

Reference is made to the cutting tests of Cincinnati Milling Machine Co., showing that the cutting force of diamond tools is much lower than that of high speed steel tools. Cutting angles and forms of cutting edges are discussed. Recommendations for the design of commutators are given, avoiding tools with point angles below 90 deg. Practical data on the turning of commutators (copper-mica laminations). Drum controllers are efficiently turned with diamond tools. Problem of undercutting mica not yet solved.

(Communicated by Industrial Diamond Review).

**Centreless Thread Grinding.** (*Aircraft Production*, May, 1945, Vol. VII, No. 79, p. 234, 10 figs.).

This development consists of grinding screw threads on a new machine adapted from the well-known Landis No. 12 centreless grinder, and is claimed to result in threads free from the inaccuracies said to be common with commercial screws produced by other methods. Experience gained up to the present time indicates that a crusher speed of approximately 150 ft./min., is satisfactory for crushing a four-inch wide grinding wheel. In general, it takes about one minute of crushing to remove 0.001 in. from the radius of the grinding wheel. Diamond dressing of the grinding wheel is used for truing before crushing the grooves into the wheel and also for dressing the chamfer or "throat" at the entrance edge after the grooves have been crushed. Chamfering is done for two purposes: first, to centreless grind the O.D. of the blanks before threading begins; second, to form the threads gradually so that the metal removal is distributed across the face of the wheel and the full depth grooves remain to clean and true the thread form of the screw as it leaves the grinding wheel. In order for the screw to thread its way through the throat between the grinding wheel and the regulating wheel, the grinding wheel axis must be at the helix angle with respect to the path of the screw. Except for the fact that the grooves on the crusher are annular and the groove on the screw is a helix, the depth of the groove form, and the width of top flat and width of bottom flat are almost identical. Automatic loading can be provided.  $\frac{1}{4}$ —20 screws can be ground at an economical rate of 30 to 35 in. length per minute. It has been possible to operate continuously for eight hours without recrushing the form on the wheel. During this time from 12,000 to 16,000 screws of  $\frac{1}{4}$  in. length can be ground. These figures are compared with about 2,500 to 3,000 by an automatic screw machine. The following claims are made for set-screws ground on the centreless thread grinder: (a) Lead error is reduced and may be 0.0005 in. per inch or less, depending on the rate of production. (b) In all cases where the major diameter of the screw is ground throughout the length of the screw, the pitch diameter value is constant and concentric with the major diameter. (c) The sides of the threads are smooth and straight. (d) The angle is as accurate as the angle of the crusher grooves, and checking on a comparator has shown that the angle is 60 deg.

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**High-production Broaching.** (*Machinery*, 12th April, 1945, Vol. 66, No. 1696, p. 389, 8 figs.).

A number of unusual examples of broaching-machine applications are illustrated and described. These include the broaching of propeller hubs with extreme accuracy, and multiple broaching components held in turrets.

### CHIPLESS MACHINING.

**New Precision Forging Methods**, by Hans Haller. (*Machinery*, 5th April, 1945, Vol. 66, No. 1695, p. 369, 7 figs.).

Part 2. The foremost problem in forging is the precision profiling of parts. By precision forging is meant close approximation to finished form, thus producing but small quantities of surplus material, and the production of clean surfaces. This latter can often be attained only by the introduction of further operations. Hence reforging and stamping must be employed for those parts which are not finish machined except on their mating and running surfaces. Examples show how these exacting requirements can be met. These include a rocker previously drop-forged solid, a brake lever with drop-forged serrations which require no subsequent machining, a clamping shoe requiring several operations, and a forging with thin sections.

### MANUFACTURING METHODS.

**Manufacturing the Hercules Piston**, by J. A. Oates. (*Aircraft Production*, April, 1945, Vol. VII, No. 78, p. 176, 23 figs.).

Part II. Fettingling and heat-treatment: Later stages of machining: Diamond-turning and boring: Final inspection.

**Common Factors of Time Study in Light Industry**, by S. Bloye Dipple. (*Mechanical World*, 27th April, 1945, Vol. 117, No. 3043, p. 455, 3 figs.).

Part 5. Standard times and synthetic set-ups are fully discussed with the aid of examples. The methods of treating machine times are divided into two classes: (1) Where the operator controls the rate of machining as in the case of a hand-fed drill; (2) Where the element is automatic.

**Flow Reconditioning of Machine Tools.** (*Machinery*, 19th April, 1945, Vol. 66, No. 1697, p. 417, 12 figs.).

Methods used in the rebuilding of Brown & Sharpe automatics.

### MATERIALS, MATERIAL TESTING.

**Reclamation of Aluminium, Parts I and II**, by A. Rathbone. (*The Machinist*, 11th and 21st April, 1945, Vol. 89, Nos. 1 and 2, pp. 1 and 41, 8 figs.).

High-grade secondary aluminium is produced by correct control of remelting furnaces, and use of proper fluxes. Quality is high and meets rigid specifications for casting engine parts. Special techniques are required for the satisfactory remelting of large and small swarf, as well as foundry residues. Temperatures, heating times, and fluxes are given consideration.

**Some Recent Developments in Engineering Materials**, by Archibald Black. [*Mechanical Engineering (U.S.A.)*, March, April, 1945, Vol. 67, Nos. 3 and 4, pp. 190, 267.].

Part 2. Nonferrous metals. A general review, with full bibliography.

Part 3. A review of synthetics, fuels, and lubricants. Full bibliography.

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**Advances in Rubber During 1944**, by John W. Liska. [*Mechanical Engineering*, (U.S.A.), April, 1945, Vol. 67, No. 4, p. 262.]

General survey, with extensive bibliography.

**Advances in Plastics During 1944**, by G. M. Kline. [*Mechanical Engineering* (U.S.A.), April, 1945, Vol. 67, No. 4, p. 255.]

A general survey. A very full bibliography is given.

**Automatic Rockwell Hardness Testing Apparatus**, by O. Wolpert. (*Industrial Diamond Review*, April, 1945, Vol. 5, No. 53, p. 73).

A German automatic hardness tester has been developed which can be provided with additional attachments according to the kind and number of workpieces to be tested. In the case of large numbers of uniform pieces, the testing time can be reduced to only four seconds per piece with simultaneous automatic sorting into "correct," "too hard" and "too soft" pieces. The danger of interchanging workpieces, through reading mistakes, can be avoided by automatic marking, alternatively, a selecting attachment can be provided.

(Communicated by the *Industrial Diamond Review*).

## MEASURING METHODS.

**Air-operated Gauges**. (*Production and Engineering Bulletin*, April, 1945, Vol. 4, No. 28, p. 121, 15 figs.).

Two examples of British practice give some indication of the scope of this method of gauging. One type of unit being used in the gauging of 20 mm. shells checks four dimensions simultaneously. Over a period of twelve months one of these units in the hands of relatively inexperienced girl operators has checked  $4\frac{1}{2}$  million shells at an average rate of about 900 per hour. Another type of unit, based on the same principle, but much simpler in construction, has been applied in gauging the thickness of mica films ranging from 0.0008 in. to 0.0032 in. thick, at the rate of 25 to 30 films per minute, the gauging accuracy of this particular equipment being  $\pm 0.000025$  inch. The principle construction and use of these gauges are described.

**Routine Inspection by Optical Projection**. (*Machinery*, 26th April, 1945, Vol. 66, No. 1698, p. 445, 10 figs.).

Developments at the works of Dunlop Rim & Wheel Co. Ltd.

## RESEARCH.

**A Study of Some Fundamentals When Face-Milling Steel with Carbides**, by Fred. W. Lucht. (*Mechanical Engineering* (U.S.A.), March, 1945, Vol. 67, No. 3, p. 185, 11 figs.).

The correct radial rake to be used on carbide cutters for milling steel has generally been determined by "cut-and-try" methods. For this reason, an investigation into the subject of radial rake for the face-milling of steel with carbides has been included in the steel-milling development programme now being conducted at the engineering research laboratory of the author's company. S.A.E. 1045 steel was selected as the material to be machined on a vertical milling machine. The cutter head of the face-milling cutter was made from a steel forging. The tool bit was clamped in place by set screws. Eleven different designs of tool bits were used. Each had a 10-deg. negative back rake. The side rakes were 15, 12, 10, 8, 5 and 2 deg. negative; zero deg.

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and 2, 5, 8 and 10 deg. positive, respectively. When the tool bit was assembled in the cutter head, each of these side rakes produced a corresponding radial rake. The addition of a flywheel made it possible to obtain uniform results where before they had been erratic. A speed of 238 r.p.m. (498 f.p.m.), a feed of 2 i.p.m., and a depth of cut of  $\frac{5}{32}$  in. were selected for all tests. Each tool was run until the first sign of wear, a well-defined deep blue line paralleling the length of the chips, appeared. The following conclusion was reached: the best operating conditions will be obtained when milling steel with carbides if the face of the tooth first contacts the work at a distance equal to the feed per tooth back from the cutting edge, and at a distance from the face of the cutter which is equal to the depth of cut.

**Kurzpruefverfahren zur Ermittlung der Zerspanbarkeit von Staehlen und der Schneidhaltigkeit von Werkzeugen beim Drehen im Feinschnitt. Short Test Method for Determining the Machinability of Steels and the Life of Tools when Fine Turning**, by H. Luepfert. (*Archiv fuer Eisenhuettenwesen*, September/October, 1943, Vol. 17, pp. 89-98).

When comparing the machinability of un-alloyed and alloyed structural, tool and H.S. steels by measuring cutting pressure, cutting temperature, and blunting of the tool edge, the author found that increase in the cutting speed—shortened Leyensetter method—has proved quick and reliable. Additional measuring of wear width is dispensable.

(Communicated by "Industrial Diamond Review.")

### SHOP ADMINISTRATION.

**Administrative Engineering**, by D. Tiranti. (*Aircraft Production*, April, 1945, Vol. VII, No. 78, p. 198.).

Most executives agree that the efficiency of our factories must be raised in order to face post-war competition. In this article, the author puts forward a plea for more attention to be given to the administrative side of engineering and its establishment as a separate function.

## INSTITUTION NOTES

*May, 1945*

**1945.**

### **June Meetings.**

- 9th Shrewsbury Sub-Section. A lecture will be given by Dr. W. A. J. Chapman on "Surface Formation and Location," at the Technical College, Shrewsbury, at 3-0 p.m.
- 19th Wolverhampton Graduate Section. A lecture will be given by Dr. J. D. Jevons, on "Deep Drawing and Pressing," at the Wolverhampton and Staffordshire Technical College, at 7-0 p.m.
- 26th Wolverhampton Section. A lecture will be given by A. B. Lloyd, A.M.I.P.E., on "The Production of Steel Castings," at Wesmore Schools, Wollsal at 6-30 p.m.

### **July Meetings.**

- Wolverhampton Graduate Section. Special Meeting for Graduates and Students only (No Visitors) "Brains Trust." Full details to be announced later.
- 7th Shrewsbury Sub-Section. A lecture will be given by R. C. Fenton, Esq., on "Negative Rake Cutting," at the Technical College, Shrewsbury, at 3-0 p.m.

COVENTRY SECTION. B. Newbold, Esq.; M.I.P.E., was elected President of the Coventry Section.

SHREWSBURY SUB-SECTION. The first meeting of the Shrewsbury Sub-Section was held at the Technical College, Shrewsbury, on 17th March, 1945, when H. F. Hodgson, Esq., Director and General Manager, Messrs. Joseph Sankey Ltd., Hadley, lectured on "Foremanship." The lecture was followed by a lively discussion. The attendance at this meeting was 59 members and visitors. It was generally agreed that the meeting was a great success and argued well for the future meetings of the Sub-Section. Letters of thanks have been sent to Mr. Hodgson and to Mr. A. Moore, Principal of the Technical College, Shrewsbury.

WOLVERHAM\*TON SECTION. In collaboration with "The Wolverhampton District Production Committee," the Wolverhampton Section, I.P.E., arranged for a series of five lectures on "Statistical Quality Control" to be held at the Wolverhampton Technical College during March. This arrangement proved very successful,

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the maximum attendance being 120, the minimum 80, with an average over the five lectures of 90 members and visitors.

### Honours List.

Since the publication of the April Journal information has been received that J. M. Lawrence, Esq., A.I.P.E., Production Manager of Mitcham Works, Ltd., was amongst those who received the M.B.E. in the New Years Honours List. We extend to Mr. Lawrence our congratulations on the honour conferred upon him by His Majesty the King.

### Personal.

J. G. Bulgar, Esq., A.M.I.P.E., has been appointed General Manager of Combined Optical Industries Ltd., Plasta Works, Slough, Bucks.

M. Seaman, Esq., M.Sc., A.M.I.P.E., A.M.I.Mech.E., M.Inst. Brit.F., has recently resigned his appointment as General Works Superintendent of the Ironworks Branch of Messrs. Newton Chambers & Co., Ltd., and has taken up his new appointment as General Manager of P. R. Jackson & Co., Ltd., Manchester—a company of the David Brown Group.

### Obituary.

We deeply regret to record the death of H. O. Page, Esq., A.M.I.P.E., Joint Managing Director of Weir Precision Engineering Ltd.

### “Unification of Screw Threads.”

The I.P.E. are arranging jointly with the Institution of Mechanical Engineers a whole-day Conference on “Unification of Screw Threads,” to take place on 22nd June, at the Institution of Mechanical Engineers.

### Council Meeting.

The next Meeting of the Council will be held on Friday, 15th June, 1945, at the Institution of Civil Engineers, Gt. George Street, S.W.1.

### Books Received.

*Damping Capacity*, by B. Fulman.

*Management Accountancy*, by Thos. W. Fazakerley.

*Spinning and Panel Beating of Aluminium Alloy*. Information Bulletin No. 9, issued by the Wrought Light Alloys Development Association.

*Aeronautics*. Nos. 3. and 4. Monthly Survey of Published information from the World's Scientific and Technical Press, compiled by M.A.P.

# INDEX TO ADVERTISEMENTS

As a war-time measure the advertisement section of this Journal is now published in two editions, A and B. Advertisers' announcements only appear in one edition each month, advertisements in edition A alternating with those in edition B the following month. This Index gives the page number and edition in which the advertisements appear for the current month.

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Snow & Co. Ltd. ....	xxv B
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Wolverhampton Die Casting Co. Ltd. ....	xix B

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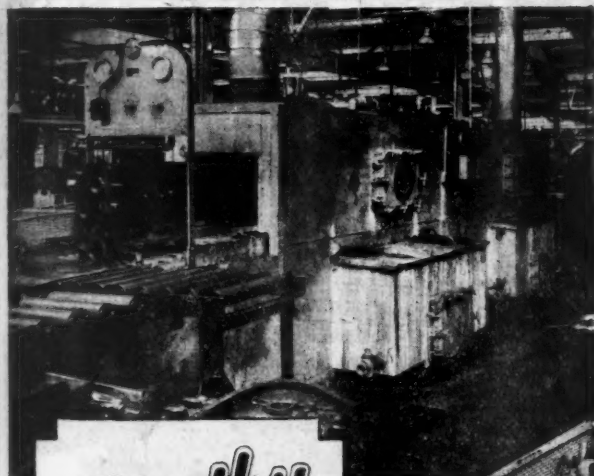
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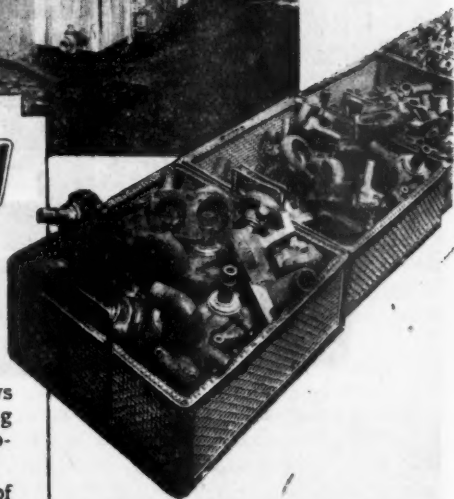


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This illustration shows  
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It is equally capable of  
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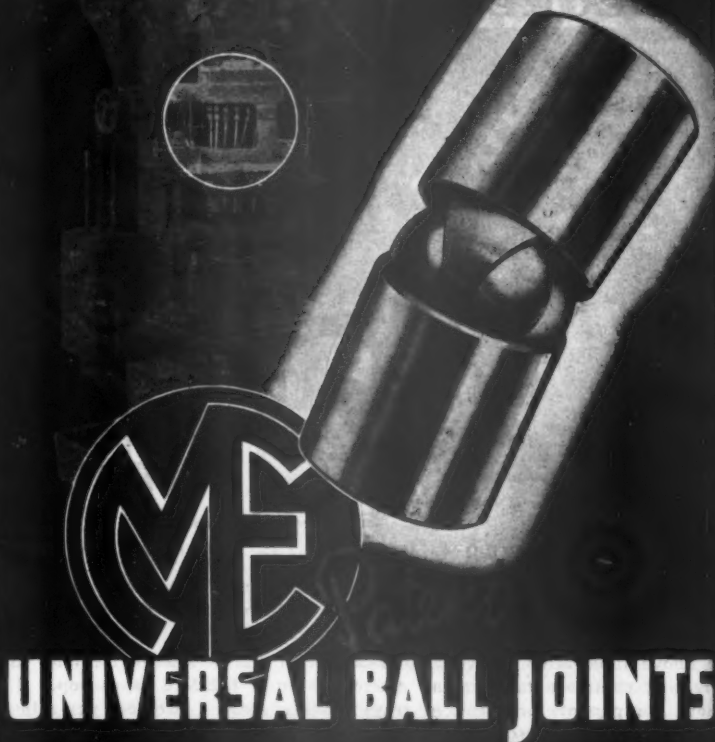
The above illustration shows a Dawson Metal Parts Washer cleaning and degreasing complete tank engine assemblies in a R.E.M.E. workshop. The various components are seen in trays passing along a two foot per minute conveyor into the Dawson Washer where they are subjected to a high pressure solution wash by batteries of jets and returned clean and ready for handling.



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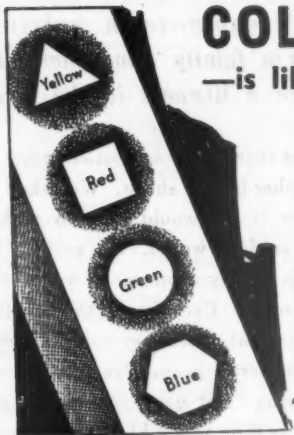
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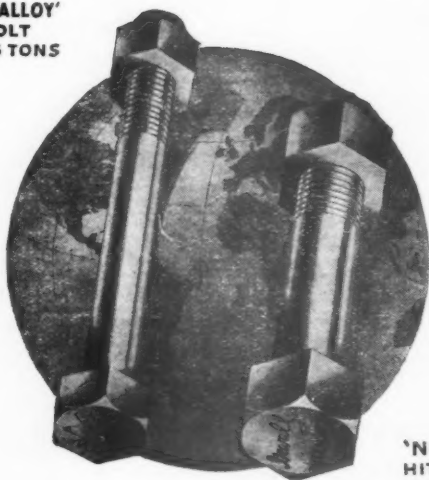
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